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(54) **Title:** SYSTEM AND METHOD FOR PROVIDING A CONNECTION IN A COMMUNICATION NETWORK
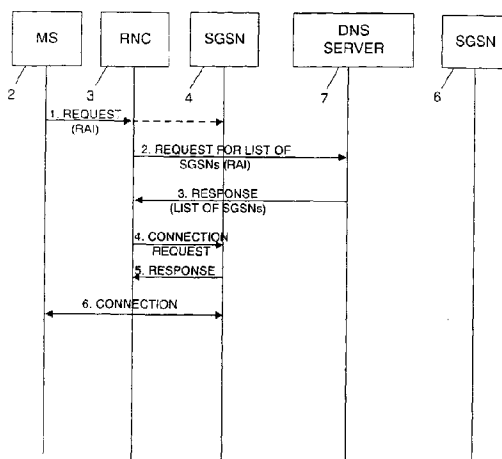
(57) **Abstract:** The invention proposes a system and method for providing a connection in a communication network which comprises several network elements and is adapted to route a connection via a first network element such as a radio network controller and one or more of alternatively selectable second network elements such as serving nodes. The network comprises a network element which stores a list of selectable second network elements. The list is accessed using an identifier identifying a routing or location area or a desired second network element. The list can be stored in a DNS server which returns to an inquiring network element such as a radio network controller, e.g. IP addresses of serving nodes capable of serving a routing or location area of a connection originating or terminating network element. The connection originating or terminating network element may also be adapted to send an identifier identifying a specific network element such as an SGSN to which it desires to be connected.

# SYSTEM AND METHOD FOR PROVIDING A CONNECTION
## IN A COMMUNICATION NETWORK

### FIELD OF THE INVENTION

The present invention relates to a system and method for
10   providing a connection in a communication network. The
communication network may be a pure data network, a network for
transmitting data and/or other type of information such as
speech or may be a network exclusively reserved for non-data
information. The network can be a circuit-switched network, a
15   packet-switched network such as a GPRS or UMTS network, or may
consist of a combination of networks of different type.

### BACKGROUND OF THE INVENTION

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When providing a connection in a communication network, usually
several network elements are involved, including the connection
originating network element, the connection terminating network
element and/or one or more intermediate network elements such
25   as a base station, a base transceiver station, a base station
controller and/or one or more support nodes handling the
signalling and/or user traffic.

As an example, in a GPRS-based or UMTS-based network, a
30   connection (e.g. call) originating from, or terminating at, a
user equipment such as a mobile station (MS) is made to a
connection terminating or originating equipment using a radio
network controller (RNC) which communicates with a SGSN
(Serving GPRS Support Node) and possibly a GGSN (Gateway GPRS
35   Support Node). The connection terminating or originating
equipment can be located in the same or a different network. In
particular, in case of mobile user equipments, the actual
location thereof is defined with a resolution of a routing area

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(e.g. in idle state) or with a finer resolution of a cell (e.g. when handling a connection such as a call). Note that Routing area (RA) is a standard term used in conjunction with GPRS, while GSM and UMTS Circuit Switched systems use the term Location Area (LA). In both case, the area is referring to the area where a mobile station is registered in the serving node (e.g SGSN or MSC/VLR), and where eventually the serving node pages the mobile station to establish downlink connection. In this application, the term area will be used to refer to location area and/or routing area.

The coverage area of an entire network is usually divided in several areas (RA or LA), with one area (in a GPRS-or UMTS-based network) being assigned to one serving node (one serving node typically handling many areas). When having information on the area where the user equipment is presently located, the serving node in charge of handling a connection to or from this user equipment is unambiguously defined.

For example, in GSM and UMTS, this one to one correlation between the routing or location areas and the assigned SGSNs may, however, be of disadvantage in case of break-down of an SGSN or necessary maintenance operations such as software updating. In such a case, the routing area has to be completely shut-down and is at least temporarily no longer usable for providing connections.

This situation may be significantly improved when changing the network structure in such a manner that at least two serving nodes such as two SGSNs are able to handle the same routing area. In such a case, e.g. a base station controller (BSC) or radio network controller (RNC) may use different interfaces such as Iu and/or Gb. Several types of mobile stations may be supported by using two radio interfaces and providing only one single base transceiver station (BTS).

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The provision of two or more support nodes serving the same
routing area provides several advantages such as resilience by
enabling an RNC (possibly having a list of available SGSNs) to
use another SGSN if the previously used SGSN should become
overloaded or out of order. Furthermore, maintenance operations
such as software updates can be effected without shutting down
the area. In addition, the network signalling caused by inter-
SGSN hand-over can be reduced.

As an example, several SGSNs may be provided for covering a
metropolitan area such as London area, and a mobile station
moving around the city can always use its original SGSN for
handling connections.

For instance, an IP network may be introduced on an interface
such as Iu interface which presently is mainly used as a point-
to-point Iu interface between the RNC and the SGSN. When
introducing an IP network or network of some other appropriate
type on the Iu interface, one RNC may be connected to several
SGSNs.

In a case where one network element (which e.g. is in charge of
controlling the radio connection to a user equipment) is able
to connect to different support nodes being alternatively
provided, there exists a problem in finding and selecting an
appropriate support node, for instance an SGSN to be used for a
signalling connection. This signalling connection may e.g. be
used to transfer L3 (layer 3) messages (such as mobility
management MM and session management SM) between the user
equipment (e.g. MS) and the support nodes such as SGSN.
Furthermore, in case of inter-support node hand-over the new
support node would benefit from finding the old support node
which was serving the user equipment until hand-over.

**SUMMARY OF THE INVENTION**

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The present invention provides a solution for solving or at least relieving the above problems either partly or entirely.

According to one aspect, the invention provides a system as defined in claim 1. This system may consist of a whole network, may be only a part of a network, or may comprise two or more networks.

According to a further aspect, the invention provides a method as defined in the independent method claim.

The invention additionally provides, according to a further aspect, one or more network elements equipped so as to implement the hardware structure or functions usable in a network or connection or selection method as defined in the claims and/or described in the present specification.

The present invention provides a solution for allowing a first network element such as a radio network controller or base station controller to decide which support node (e.g. SGSN) to use for a connection (e.g. signalling connection or user traffic connection). A signalling connection is provided for transferring messages such as L3 messages, e.g. MM and SM, between a network element such as a user equipment, e.g. MS, and the support node. Hence, the first network element may be alternatively connected to different support nodes serving e.g. the same routing area. Such an implementation provides the advantages mentioned above.

The invention is also providing, in case of hand-over of a connection between different support nodes such as SGSNs, a structure and method enabling the new support node to find the old support node serving the user equipment up to now.

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In accordance with the invention, an area identifier such as
"Routing Area Identity (RAI)" may be used by the first network
element (e.g. RNC) to derive a list of alternatively selectable
second network elements such as support nodes. In this list
different support node are identified by their addresses. This
list may be preconfigured inside the RNC. According to another
embodiment, the first network element may send a message or
request containing the identifier (e.g. RAI) to another network
element such as a DNS (Domain Name System) server in order to
receive, as a response, a list of possible second network
elements serving the routing area indicated by the RAI. This
avoids the need of preconfigured list, and DNS is particularly
suitable if the list of possible second network elements
contains IP addresses.

The another network element preferably contains, or co-operates
with, a memory storing the list (table) of possible second
network elements, and may send this list as a rolling or
distributed list to spread the load. The list may for instance
be sent in form of several parts, each part indicating only one
or two (or more) selectable second network elements. The list
may be ranked in a defined order, for instance based on the
address of the first network element sending the list request
or indicating first a default second network element for this
area. The ranking may be such that the first of the second
network elements indicated in the list is always the closest
one to the first network element, the second of the listed
second network elements being the second closest one to the
first network element, etc.

The order of listing of the second network elements in the list
may also, in an embodiment, be based on information on the
actual or previous load of each listed second network element.
As an alternative, the order of listing of the second network
elements may be kept unchanged, but additional information is
attached to the list indicating the actual or previous load

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condition of the listed second network elements. In the latter
case, the first network element is adapted to check the load
condition information as well, and to select one of the second
network elements having the smallest load or at least being one
of the lighter-loaded second network elements.

The modification of the order of the listing of the second
network elements taking account of the load, or the attachment
of the load information to the list, is preferably performed by
the operation and maintenance system (O&M) provided for the
network.

According to one possible implementation of the invention, a
second network element for which a maintenance operation such
as software updating is planned, may be withdrawn from the list
(to be sent to an inquiring first network element) some time
such as a few hours before the software update. In such a way,
one can ensure that no or at least not many connections or
contexts will still be handled by this second network element.

According to one possible implementation of the invention, if a
second network element is not responding, another second
network element may be selected from the list

According to one possible implementation, the identifier such
as CN (Core Network) Identifier  may be added to a message,
e.g. RRC (Radio Resource Control) message which is used to
initiate a connection and/or carry a message such as a L3
message (e.g. Attached Request, Routing Area Update Request or
Service Request). The first network element (e.g. RNC) checks
the identifier (e.g. CN Identifier ) from the RRC message
message. In addition, the first network element may also be
adapted to deduce the area identifier such as RAI from the cell
where the user equipment is actually located. The combination
of area identifier and CN Identifier identifies unambiguously
the serving node. The first network element derives the serving

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node address from a list. In one embodiment, the first network
element uses the area identifier and/or the CN identifier to
request the list-transmitting network element such as a DNS
server to send a list of second network elements assigned to
the transmitted identifier.
Certain systems, such as GSM or UMTS systems have different
types of serving nodes (e.g. SGSN and MSC/VLR) serving the same
area. In the UMTS system, the RRC signalling contains a
parameter (CN domain identity) identifying the CN type. In GSM,
the CN type is identified implicitly from the type of channel
established.

In such systems, the indication of CN type in addition to the
combination of area identifier and CN Identifier may be needed
to identify unambiguously the serving node.

According to one possible implementation of the invention, one
of the second network elements may be set as a default second
network element serving the routing area in which the
connection terminating or originating equipment such as MS is
presently located. The first network element will be configured
to use this default second network element for handling a
connection as long as no other second network element is
selected (i.e CN identifier is not sent by the MS).

In accordance with an embodiment of the invention, the
selection of one of the available second network elements
covering a certain routing area may be performed in dependence
on information coming from other network element such as a user
equipment, for instance a mobile station. If the user equipment
wants to establish a connection, e.g. a signalling connection,
to a certain support node (second network element) which for
instance had previously handled the connection to and from this
user equipment, the user equipment is preferably adapted to
send additional information such as CN identifier to e.g. the
first network element which may be a RNC. As an example, the

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user equipment had established a signalling connection to a
certain support node, e.g. SGSN, whereafter the signalling
connection had been released, and the user equipment wants to
establish the signalling connection again to the same support
node.

In accordance with one aspect of the invention, the user
equipment may then add an identifier information such as CN
identifier to a message which, e.g., may be used to carry an L3
message (e.g. a Routing Area Update Request or Service
Request). If the MS moves to a new area which cannot be handled
by the previous serving node in which it is registered, RNC
will select a new serving node, and the new serving node will
be able to derive the old serving node address by using the
combination of CN identifier (added according to this
embodiment to Routing Area Update Request) and old RAI (sent in
Routing Area Update Request in GSM and UMTS). In addition, or
as an alternative, the first network element (e.g. RNC) may
check the information CN identifier from the L3 message.

The new serving node should send its CN identifier in e.g.
Routing Area Update accept, or attach accept to the MS.

The invention furthermore provides a possibility of finding and
selecting an old support node (e.g. old SGSN) by a new support
node, in particular after inter-node hand-over. Note that in a
structure in which the old SGSN can be found with the old RAI
(when only one SGSN serves a specific routing area designated
by RAI), there is no problem in finding the old SGSN. However,
in a situation where a routing area is covered by several
support nodes in parallel, it will be advantageous if the new
support node is able to detect the old support node in order to
e.g. copy context information for handling the connection such
as PDP (Packet Data Protocol) context information.

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According to one aspect of the invention, the network element storing the list of second network elements (i.e. support nodes) covering a certain area such as RA (Routing Area) or LA (Location Area) may additionally store, for each support node, an CN identifier identifying this support node. This identifier may be sent as a new Information Element (i.e. it is sent explicitely) or may be coded as part of another Information Element such as a temporary identity (i.e. it is sent implicitely). As an example of sending the CN identifier implicitely, CN identifier may be formed by some bits (e.g. 4 last bits) of PTMSI (Packet Temporary Mobile Station Identity). The network element storing the list of second network elements available for the respective areas (e.g. RA or LA) can be a DNS server, and preferably stores the list of support nodes mapped to the respective area indicators such as RAIs (Routing Area Identities) or LAIs (Location Area Identities). This network element may return, in response to an area indicator sent to it, not only the IP addresses of every support node (second network element) assigned to the respective area (e.g. RAI), but additionally also the network element identifiers assigned to these support nodes, and eventually the type of support node. The network element in charge of selecting the second network element for handling the connection (e.g. signalling connection) may then select that second network element which has an network element identifier corresponding to the network element identifier transmitted e.g. from the user equipment as selection criterion. As an alternative, the network element storing the list may be queried with both CN identifier and area identifier, so that only the address of the right support node is returned.

The type of support node may be used e.g. in a network comporting both 2G and 3G SGSN. In this case, a RNC (3G only) may only select a support node indicated as a 3G support node, based on the type of support node indicated.

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In order to avoid processing problems, according to one aspect
of the invention, one of the second network elements (e.g.
SGSN) available for a routing area may be a master network
element which, if not handling itself the context information
such as PDP context, may act as a relay, and may determine the
old second network element based on e.g. the identifier sent
for instance from the user equipment together with PTMSI. In
such a case, the identifier may have been sent from the old
support node to the user equipment together with PTMSI during
(e.g. at the begin or end) of the time period during which it
was in charge for handling the connection to the user
equipment. The user equipment hence knows the supporting
network element such as the support node which handled its
connections. This embodiment may be particularly applicable if
the SGSN where the MS moved was not upgraded to find the
appropriate old (i.e. previous) SGSN.

The second network elements may also be MSCs (Mobile Switching
Centres) or other types of serving elements, e.g. in circuit-
switched networks.

The solutions provided by the present invention are furthermore
applicable in a case where network elements of different
generation (such as 2G SGSN and a 3G SGSN) are provided which
handle the connections for the same routing area. The selection
of the support node may be made depending on the type of the
connection established and/or requested, or on the type of the
user equipment. As an example, the invention may be employed in
a GERAN system (GSM/EDGE radio access network).

The present invention allows an effective adaptation of a
cellular network being at least partly IP-based. IP networks
are essentially peer-to-peer structured whereas the
conventional cellular networks such as GSM, UMTS, etc. are
typically based on an hierarchical architecture wherein a radio
access network (RAN) or, in more detail, a controller

controlling the radio access such as a RNC, RNS, BTS, BSS and the like, is handled by a single serving node (e.g. MSC/VLR; SGSN;...).

The invention generally proposes a structure and method wherein one network element providing e.g. radio access (e.g. RAN) to a user equipment is connected to many serving nodes such as core network (CN) nodes. This reduces the number of inter-CN-node-area update procedures and increases the reliability. The invention hence proposes a new architecture for a cellular system wherein one radio access network (or the network element providing or controlling the radio access) as well as a location area (LA) or routing area (RA) can be handled by many serving nodes of the same type. A routing function for deciding to which serving node the connection is to be made, is preferably located in the radio access network (RAN) or the respective network element providing or controlling the radio access, and is not located between the radio access network and the serving node, or in the serving node. The routing function located in the RAN additionally provides or comprises a method for selection of the serving node to connect to.

Furthermore, the method and system according to the invention may be used to detect the node where a user equipment is actually registered, one of the network elements having a list of serving nodes serving the present location area (or routing area) of the user equipment. Preferably, this list includes a default serving node. The serving node to be used for handling the connection is preferably determined in the following manner: When the user equipment has not sent an identifier such as a core network (CN) identifier, the default serving node, if defined, will be selected from the list. If the user equipment has sent an identifier such as a CN identifier, a serving node corresponding to this identifier will be selected. The default serving node may be defined to be the serving node mentioned on a specific position of the list for the routing or location

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area, e.g. the first serving node mentioned on the list. When
no identifier is sent from the user equipment, the serving node
mentioned on the specific place, e.g. the first-mentioned
serving node, is selected by the RAN from the list.

This method and structure can be used by the radio access
network (or RAN controlling node or component) to find the
serving node to be used. Likewise, this method and structure
can be used by the new serving node to find the old serving
node to which the user equipment was registered, or may be used
by the new serving node to find the MSC/VLR to which the user
equipment was registered, in particular in a case when the Gs
interface is used.

In accordance with one aspect of the invention, a user
equipment such as a MS may be adapted to select a serving node
by using a CN identifier. The CN identifier may be the latest
used identifier, or may be a preconfigured, i.e. predetermined
CN identifier which is stored in the user equipment, e.g. on a
SIM card thereof. This aspect is claimed in claims 40 to 44.

Furthermore, the method and system according to the invention
may be used to allow many operators (each owning their own
serving node) to share a common Radio Access Network (owned by
another operator). If every operator uses a different CN
identifier, and if the MSs are configured to always use same CN
identifier (even in the very first attach request) based on
subscription information typically read from a SIM card, then
the MS will always be connected to an SGSN owned by this
operator (from which they bought SIM card).

The invention thus likewise provides a system as defined in
claims 45 to 47, and/or network elements as defined in the
further claims.

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**BRIEF DESCRIPTION OF THE FIGURES**

Fig. 1 shows a basic structure of one embodiment of a system in accordance with the invention;

Fig. 2 illustrates the message flow for establishing a connection between a user equipment and a serving node;

Fig. 3 shows a method for selecting a desired serving node;

Fig. 4 illustrates a message flow in a system and method according to a further embodiment of the invention;

Fig. 5 shows details of a table stored in a DNS server;

Fig. 6 illustrates the method steps performed in a Routeing Area Update Procedure according to an embodiment of the invention related to UMTS; and

Fig. 7 shows steps performed in a Combined Cell / URA Update and SRNS Relocation Procedure according to another embodiment of the invention.

**DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION**

Fig. 1 shows the basic structure of an embodiment of a system in accordance with the invention. The system is implemented as a network 1, or forms a part thereof, which network 1 comprises at least one, or usually a plurality of, user equipments 2 which, in this embodiment, are implemented as mobile stations MS. The user equipments may also be any other type of equipments such as stationary terminals. Although only one user equipment 2 is shown, usually several user equipments are attached to the network 1 and represent connection originating or terminating equipments.

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In case of connection, or connection set-up, with another
equipment forming part of network 1 or of another network, a
radio connection to user equipment 2 is provided and handled by
a radio access network (RAN). The RAN comprises, in this
embodiment, a radio network controller (RNC) 3 which is part
of, or represents, the radio access network for radio
connection to user equipment 2. Usually, several radio access
networks and controllers 3 will be provided in the network 1
for radio coverage of the different areas of the network 1. The
RNC 3 (first network element) may be selectively connected to
different serving nodes which, in this embodiment, are
implemented as SGSNs 4 and 6.

The network may comprise additional or alternative serving
nodes such as mobile switching centres (MSCs) which normally
will be combined with visitor location registers (VLRs). The
serving nodes 4, 6 may be connected, if necessary, to a gateway
node 5 which here is a GGSN and provides the possibility of
connection to other networks.

In addition, a DNS (Domain Name System) server 7 is provided
which may form part of network 1 or may be a network-external
component. The DNS server 7 can be accessed by RNC 3, and
usually also by other network components such as serving nodes
4, 6 and/or gateway node 5. The communication possibilities are
shown in Fig. 1 as double-headed arrows.

The DNS server 7 comprises, or has access possibility to, a
memory (not shown) storing lists (tables) of serving nodes
available for alternatively covering routing areas or location
areas of the network 1.

Fig. 5 shows an example of a table stored in the memory.
According to this example, the table contains several columns
and rows. The left column "SGSN" lists the available serving
nodes. SGSN1 may correspond to SGSN 4, SGSN2 may correspond to

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SGSN 6, and SGSN3, SGSN4 may correspond to further serving
nodes not shown in Fig. 1 and covering other routing or
location areas of the network 1. The table furthermore,
contains a column "IP address of SGSN" listing the IP addresses
of the individual available serving nodes. The column "SGSN
name" or "(SGSN identifier)" lists the identifiers identifying
the individual serving nodes. In this example, the type of the
node (2G or 3G) is built in the identifier. The column "Routing
Area" lists the routing areas or location areas being covered
by the individual serving nodes. As an example, the serving
nodes SGSN1 SGSN2, SGSN3 and SGSN4 are available for covering
the same first routing area RA1 whereas the serving nodes SGSN1
SGSN2, SGSN3 and SGSN5are available for alternatively covering
a second routing area RA2 in which a mobile station may be
located, e.g. after moving thereto from routing area RA1.

Depending on the details of implementation of embodiments of
the invention, the stored list does not necessarily contain all
columns shown in Fig. 5. For instance, the column " SGSN"
and/or "Routing area" (if all RAs handled by RNC use same CN
identifier, and the list is specific per RNC) may be omitted.
Alternatively, the list may also contain additional information
useful for selecting an appropriate serving node. For instance,
a column "serving node type" and/or a column indicating default
nodes for some or all respective areas may be added.

Generally, the architecture of a network or system according to
the invention comprises two or more CN (Core Network) nodes of
same type(e.g. MSC and/or SGSN) which are connected to the same
radio access network or node RAN (e.g. BSS "base station sub-
system"; UTRAN "UMTS Terrestrial Radio Access Network"; GERAN
"GSM/EDGE Radio Access Network") and assigned to the same
location area (LA) and/or routing area (RA). One or more of the
provided RANs contain, or are able to download from a network
element such as the DNS server 7, a preconfigured list of CN

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nodes. Preferably, the CN nodes are associated with a CN
identifier which is unique at least for the assigned LA/RA.

The system and method according to preferred embodiments of the
invention are preferably structured in such a manner that each
time when a user equipment registers into one location or
routing area (e.g. by performing an Attach or Area Update
procedure), the CN node handling the registration returns its
CN identifier to the user equipment, e.g. in the MM (Mobility
Management) signalling. The user equipment is adapted to store
a received CN identifier representing the serving node actually
handling a connection. Furthermore, the user equipment may be
designed to indicate the CN identifier (if known and/or if a
re-establishment of the connection to a previously used CN is
desired), if desired, when the user equipment establishes a
connection to the radio network. The CN identifier may be
indicated for instance in the radio signalling, e.g. during RRC
connection establishment.

In order to ensure backward compatibility, the new information
element (identifier such as CN identifier) is an optional
information element transmitted in both MM and RRC signalling
(if an explicit information element is used for both
protocols). This ensures that user equipments not supporting
this feature will nevertheless work with new network elements.
As such a user equipment is never sending the CN identifier, it
is always connected to a CN node which is set as a default node
to be selected when not receiving any CN identifier. Likewise,
when the user equipment should move to a RAN not supporting
this feature, the RNC is structured to ignore any CN identifier
and to establish the connection always with the only CN node it
is connected with.

If the CN node does not support this feature, no CN identifier
will be returned to the user equipment. The user equipment may
be configured to erase previously stored CN identifier, so that

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next time it is connected to the default node. In such a case, the user equipment is unable to transmit any CN identifier in the next connection request and will thus be connected to the default CN node provided for this area. In all these cases, the result is similar to existing systems.

If one CN node is not supporting this feature, it shall be configured as the default CN node.

When a GSM radio access (connection) is used in a GPRS-based network or other type of packet-based network, the TLLI (Temporary Logical Link Identifier) is sent to the base station controller BSC with every packet transfer. When considering to add a separate CN identifier, a heavy radio load would result as the CN identifier would have to be sent with every packet transfer as well. According to one embodiment of the invention, the CN identifier will be sent implicitly, i.e. encoded within the TLLI. It should be noted that TLLI is always derived from PTMSI, by changing the three first bits. . This coding may be effected by coding the temporary identity (PTMSI and TLLI) in a defined way, for instance using the 4 last bits to indicate CN identifier. This solution does neither increase the radio nor the signalling load. When sending a Routing Area Update (RAU) and/or Attach Request message, the user equipment automatically sends the old TLLI. The new PTMSI coded so as to contain the CN identifier of the serving network element serving the connection, is sent back in the RAU/Attach response message on the radio signalling level. Thus, this feature of transmitting a CN identifier can be introduced to a GPRS-based network without changes of the protocols. But it requires the BSC to implement the method described in this invention to select the right SGSN for every packet transfer.

In an UMTS network, the above solution is likewise applicable, but would require the RNC to read the PTMSI sent in L3 MM messages, which are presently only relayed by RNC. Here,

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however, it is preferred to introduce a new information element
(i.e. to send CN identifier explicitly) for identifying the
serving node in charge of the connection to the user equipment.
In an UMTS network, the RNC keeps the RRC context. Therefore,
when including the CN identifier into the RRC context, it is
not necessary to send the CN identifier often.

In a GPRS network (both GSM and UMTS), there is an additional
problem occurring during an inter-SGSN-Routing Area Update.
During such hand-over, the new SGSN needs to find the old SGSN
which handled the connection to the user equipment up to now.
For instance, PDP (Packet Data Protocol) context information
must be transferred from old SGSN to the new SGSN.

In accordance with an embodiment of the invention, the user
equipment preferably includes the CN identifier in the RA
(Routing Area) Update Request message, and the DNS server 5
returns, upon a respective query from the RNC 3 indicating the
old routing area identifier, a list of IP addresses of SGSNs in
charge of the routing area. A CN identifier is implicitly or
explicitly associated with every IP address, such as shown in
Fig. 5. The CN identifier is implicitly indicated if the
position on the list indicates the CN identifier. In such a
case, it is not necessary to separately transmit the CN (e.g.
SGSN) identifier. When, in the list example shown in Fig. 5,
the routing area identifier designates the routing area RA 1, a
list is returned from DNS server 7 to RNC 3 containing SGSN1
and SGSN2 and indicating the IP addresses thereof.

When explicitly transmitting the CN identifiers, the associated
identifiers "2G_SGSN IDENTIFIER_13" and "3G_SGSN IDENTIFIER_14"
are transmitted associated with the IP addresses. In particular
the Canonical name associated with the IP address is returned
from DNS server 7 to RNC 3 which represents the value of the CN
identifier. This concept effectively uses the structure of DNS
which is based on Canonical name (CNAME) or alias, as defined

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in e.g. RFC 1034 and 1035. Therefore, as part of the response
of the DNS, there is a transmitted a list of IP addresses and
Canonical names (CNAME), as indicated in Fig. 5 by the two
center columns and the rows associated to the same routing area
(e.g. RA1), respectively.

With this feature, the RNC or BSC can easily select the
appropriate SGSN on the basis of the technology used by the
user equipment and of the SGSN identifier, which can be
recognised from e.g. TLLI in GPRS, and extended CN identifier
in UMTS, as mentioned above.

When the CN identifier is only implicitly indicated, it is
represented by the position on the list. For instance, when not
sending the SGSN NAME identifier, the first SGSN1 is determined
as the SGSN to be used for handling the connection of the user
equipment in routing area 1, This SGSN thus serves e.g. as a
default serving node to be used for connection handling when no
CN identifier (SGSN identifier) is indicated.

Otherwise, the SGSN having an assigned CN identifier which
corresponds to the CN identifier indicated by user equipment 2,
will be selected as SGSN for handling the connection, or for
transmitting the context information to the new SGSN. In the
latter case of inter-SGSN-handover, the new SGSN can detect the
old SGSN on the basis of the CN identifier and the area
identifier which identifies the old SGSN and have been
transmitted (explicitly or implicitly for CN identifier) from
the user equipment in subsequent messages, e.g. together with
PTMSI. The RAN or new SGSN can therefore detect e.g. the IP
address of the old SGSN when sending a query to the DNS server
7.

Alternatively, a master SGSN may be provided which, when not
handling the PDP context itself, acts as a relay and determines
the old SGSN based on e.g. CN identifier. The DNS server 7, or

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alternatively or additionally, the master SGSN may have a list
of SGSNs mapped to the RAI (RA1, RA2 in the column "ROUTING
AREA" of Fig. 5). In the latter case, it is not indispensably
necessary to provide the DNS server with such a list of SGSNs
mapped to the RAIs.

This information on the old SGSN may be used by the new SGSN
for changing all PDP contexts contained in the old SGSN to the
new SGSN for a user equipment or even for all user equipments,
in particular when intending to perform maintenance operations
of the old SGSN such as software-updating.

The list of SGSN addresses and SGSN identifiers may be modified
in case of need to use another SGSN to serve one or more SGSN
identifiers. Subsequent signalling connections will then be
made to this another SGSN when sending these SGSN identifiers.
This also requires the updating of GTP tunnels for the existing
PDP contexts, etc.


Fig. 2 refers to a case, in which the radio access network
controller such as RNC 3 used the proposed method to determine
which SGSN to use for handling a connection to a user equipment
MS 2. In a step 1), MS 2 sends a request, e.g. a RRC connection
message, optionaly including the CN identifier  identifying the
serving node in which the MS 2 may be registered. The RNC 3
detects the new RAI directely from the cell where the MS is
located.. Then the RNC selects the SGN  by using a list as
depicted in figure 5 and the proposed method. This list may be
preconfigured in RNC or retrieved from another network element
like showed by step 2) and 3).
In a step 2), the RNC sends a request to the DNS server 7
requesting a list of SGSNs available for the routing area. This
request indicates the routing area identity RAI.The DNS server
7 checks the table memory containing the SGSN list such as
shown in Fig. 5, by selecting only those SGSNs corresponding to

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the indicated routing area. In a step 3.), the DNS server 7
returns the list of selected SGSNs to the RNC 3.

As an alternative to steps 2.) and 3.), the RNC 3 may also
send, in step 2.) additionally, or only, the CN identifier
received from MS 2, to the DNS server 7. The DNS server 7 is,
in this case, preferably adapted to use the CN identifier for
selection of the appropriate SGSN from the list, and returns,
in step 3.) merely the IP address of the appropriate SGSN. The
RNC 3 will then establish, in steps 4.) to 6.), a connection
using this single received IP address of the desired SGSN.

The RNC 3 selects one SGSN according to the following proposed
method:

If the CN Id is was sent in the signalling, the RNC use the
CNid as a key and the area to select the right serving node.
Note that the area do not need to be used in the special case
where the area(s) handled by RNC have same configuration (e.g.
RNC handle only one RA).

In addition, the RNC may check the type of the serving node. In
a UMTS system, an RNC when handling a packet connection, needs
to select a serving node of SGSN type (and not MSC/VLR). In
addition, if there are different SGSN types (e.g. 2G and 3G),
the RNC need to select an appropriate one, i.e. a 3G SGSN for
an RNC.

If the RNC finds a suitable serving node, it will use the
serving node address indicated in the list to establish the
connection.

If the RNC does not find a suitable node, it could select
any serving node of the suitable type supporting this area.
This selection may be done randomly to spread the load, based
on prefered serving node(s) (e.g. located close to RNC), or
based on known information of the respective load of charging
nodes (e.g. from operation and maintenance or DNS system) to
select the less loaded serving node, or a combination of the
above.

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If the CN Id is was not sent in the signalling, the RNC could select the serving node according to either of the following embodiment:

In a first prefered embodiment, where all MS are assumed to support sending of CN identifier (e.g. a GPRS system where CN identifier is implicitly coded as part of the TLLI), the RNC could select any serving node of the suitable type supporting this area. This selection may be done randomly to spread the load, based on prefered serving node(s) (e.g. located close to RNC), or based on known information of the respective load of charging nodes (e.g. from operation and maintenance procedures,or DNS system) to select the less loaded serving node, or a combination of the above. If some of the information above is implicitly indicated by the order of the list (e.g. Serving nodes ranked from less loaded to more loaded) the RNC 3 is preferably adapted to select an SGSN indicated at a specific place of the list.

In a second prefered embodiment, where some MS (typically legacy MS) are assumed not to support sending of CN identifier (e.g. first generation UMTS mobiles will not send CN identifier as part of RRC signaling), the RNC has to select a default serving node for this area. This is needed to be sure that next time a connection is established from same mobile (still not indicated its CN identifier), the same node is selected again. Of course as the default is unique per area, a new serving node may be selected when the area changes (similar to existing behaviour). In addition, when the serving node changes, in system such as GPRS, the new serving node needs to find the old serving node. The new serving node will need to also use the default serving node handling the old area when no CN identifier is sent. This way the address of the old serving node can always be retrieved unambiguously).
The RNC 3 subsequently performs, in the known manner, the necessary steps for establishing the connection between the MS 2 and the selectedSGSN 4. (proposal: move that together with fig 5 description illustrating another type of additional

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column:In addition, or as an alternative, the list of SGSNs
sent in response 3.) may contain additional information such as
load information to be checked by RNC 3 for determining on the
SGSN to be selected.)

The connection to the selected SGSN may fail, in this case the
RNC may retry with another Serving node of the appropriate type
supporting this area.

If the selected SGSN (and the connection fail) was the default
SGSN according to the second prefered embodiment, a new SGSN
may be selected as the default, typically a secondary default.
In this case, when the serving node is changing, the new
serving node will try first to connect to the default (as
previously). If the default SGSN is down or not knowing the
user, the new SGSN should retry using the secondary default
serving node handling the old area when no CN identifier is
sent. This way the address of the old serving node can always
be retrieved unambiguously.


When a SGSN is scheduled for operation and maintenance
procedures, it will preferably be excluded from the list sent
back in response to 3.) a certain or determined time interval
such as several hours before the scheduled maintenance time
point so as to avoid connections to be newly established to
this SGSN. In this case, the DNS server 7 will be informed by
the operation and maintenance system on the SGSN(s) scheduled
for maintenance operations, and will either no longer select
such an SGSN from the list, or will exclude same, when having
retrieved the available SGSNs from the memory, from
transmission to the RNC 3. Therefore, when the SGSN is shut
down for operation and maintenance procedures, the number of
registered user in this SGSN is minimum. These user connection
may just be lost, or they may be sent to a new SGSN configured
to use for this area the same CN identifier as the SGSN being
shut down.

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The steps 4.) to 6.) shown in Fig. 2 for establishing the
connection between MS 2 and SGSN 4 are the customary ones and
are therefore not explained in detail.
( I do not update Fig 3 and 4, as I think they are covered by
fig 2 description, but please double check it)
Fig. 3 refers to a case where the MS 2 is intending to be
connected to a certain SGSN 6, e.g. when re-establishing a
connection. In this case, the MS 2 sends a request such as a
RRC message which includes an SGSN identifier identifying the
desired SGSN 6. In the request 1.), the routing area identity
(RAI) or location area identity (LAI) can be additionally
indicated.

As an alternative, the RNC 3 can deduce the routing (or
location) area, and thus the routing (or location) area
identity, from other parameters. Similar to step 2.) of Fig. 2,
the RNC 3 requests, in a step 2.) of Fig. 3, the DNS server 7
to send back a list of SGSNs by indicating location position
such as RAI as a selection criterion. The DNS server 7
retrieves from the serving node list such as shown in Fig. 5 a
sub-list of IP addresses and identifiers of SGSNs corresponding
to, and being able to serve, the indicated location area. The
DNS server 7 returns this sub-list to RNC 3 a response in step
3.). The RNC 3 selects that SGSN (here: SGSN 6) from the sub-
list received in step 3.) which corresponds to the SGSN
identifier indicated by MS 2 in step 1.), and performs the
known connection steps 4.) to 6) for establishing the
connection between MS 2 and the desired SGSN 6.

As an alternative to steps 2.) and 3.), the RNC 3 may also
send, in step 2.) additionally, or only, the SGSN identifier
received from MS 2, to the DNS server 7. The DNS server 7 is,
in this case, preferably adapted to use the SGSN identifier for
selection of the appropriate SGSN from the list, and returns,
in step 3.) merely the IP address of the appropriate SGSN. The

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RNC 3 will then establish, in steps 4.) to 6.), a connection
using this single received IP address of the desired SGSN.

Fig. 4 shows an alternative or additional function of the same
or another embodiment of the method and system in accordance
with the invention. According to Fig. 4, one of the SGSNs, here
the SGSN 4, is set as a default SGSN for a specific routing
area RA. Similar to step 1.) of Figs. 2 and 3, the step 1.) of
Fig. 4 consists in sending a message such as a RRC connection
request, from MS 2 to RNC 3, indicating the routing area
identifier RAI. The RNC 3 recognises from the lack of any SGSN
identifier requesting a connection to a specific SGSN, the
possibility of selecting the default SGSN for the indicated
routing area. The RNC 3 then inquires, in step 2.) a database 8
for returning the address of the default SGSN 4, and indicates
the routing area identity in the inquiring message. The
database 8 may be structured similar to the table shown in Fig.
5 and may be contained in, or accessible by, a DNS server 7, or
another server. The database 8 returns, in response 3.), the
address of the default SGSN which address is used by RNC 3 in
the customary manner for establishing a connection between MS 2
and the default SGSN 4, as represented by steps 4.) to 6.).

Fig. 6 shows the steps of a Routeing Area Update Procedure in a
preferred implementation of the invention, related to UMTS.
Some of the modifications of this embodiment, as compared to
the specifications, are emphasized by using bold letters.

A routeing area update takes place when an attached MS detects
that it has entered a new RA or when the periodic RA update
timer has expired. The SGSN detects that it is an intra SGSN
routeing area update by noticing that it also handles the old
RA. In this case, the SGSN has the necessary information about
the MS and there is no need to inform the GGSNs or the HLR
about the new MS location. A periodic RA update is always an
intra SGSN routeing area update. If the network operates in

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mode I, then an MS that is both GPRS-attached and IMSI-attached
shall perform the Combined RA / LA Update procedures.
In UMTS, an RA update is either intra-SGSN or inter-SGSN RA
update, either combined RA / LA update or only RA update,
either initiated by an MS in PMM-CONNECTED or in PMM-IDLE
state. All the RA update cases are contained in the procedure
illustrated in Fig. 6.

The steps shown in Fig. 6 for performing a UMTS RA Update
Procedure will be described using the step numbering of Fig. 6.

1) The RRC connection is established, if not already done. The MS sends a Routeing Area
   Update Request message (P-TMSI, old RAI, old P-TMSI Signature, Update Type,
   follow on request, **CN identifier**) to the new SGSN **using on the radio interface an
   RRC message (Initial direct transfer or uplink direct transfer) including the CN
   identifier if stored in the MS. The CN identifier and the old RAI is used by the
   new SGSN to find the old SGSN.** Follow on request shall be set by MS if there is
   pending uplink traffic (signalling or user data). The SGSN may use, as an
   implementation option, the follow on request indication to release or keep the Iu
   connection after the completion of the RA update procedure. Update Type shall
   indicate:

   - RA Update if the RA Update is triggered by a change of RA;

   - Periodic RA Update if the RA update is triggered by the expiry of the Periodic RA
     Update timer;

   - Combined RA / LA Update if the MS is also IMSI-attached and the LA update shall
     be performed in network operation mode I (see subclause "Interactions Between
     SGSN and MSC/VLR"); or

   - Combined RA / LA Update with IMSI attach requested if the MS wants to perform
     an IMSI attach in network operation mode I.

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**The SNRC shall send the request to the SGSN corresponding to the CN identifier sent by the MS according to a list preconfigured in the RNC. If no CN identifier has been sent, the default SGSN for this area shall be selected (in order to support legacy MS).**

**Note: If this RNC is not connected to the old SGSN, a new SGSN shall be selected. The SGSN having in this area same CN identifier as the old one will be selected, or if not existing, another one.**

The SRNC shall add the Routeing Area Identity including the RAC and LAC of the area where the MS is located before forwarding the message to the 3G-SGSN. This RA identity corresponds to the RAI in the MM system information sent by the SRNC to the MS.

NOTE:   Sending the Routeing Area Update Request message to the SGSN triggers the establishment of a signalling connection between UTRAN and SGSN for the concerned MS.

2) If the RA update is an Inter-SGSN Routeing area update and if the MS was in PMM-IDLE state, the new SGSN sends SGSN Context Request message (old P-TMSI, old RAI, old P-TMSI Signature) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (IMSI, old RAI, MS Validated) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN responds with SGSN Context Response (Cause, IMSI, MM Context, PDP contexts). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN starts a timer.

3) Security functions may be executed. These procedures are defined in subclause "Security Function". If the security functions do not authenticate the MS correctly, then the routeing area update shall be rejected, and the new SGSN shall send a reject

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indication to the old SGSN. The old SGSN shall continue as if the SGSN Context
Request was never received.

4) If the RA update is an Inter-SGSN Routeing area update, the new SGSN sends an SGSN
Context Acknowledge message to the old SGSN. The old SGSN marks in its context
that the MSC/VLR association and the information in the GGSNs and the HLR are
invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS
initiates a routeing area update procedure back to the old SGSN before completing the
ongoing routeing area update procedure.

5) If the RA update is an Inter-SGSN RA Update and if the MS was in PMM-IDLE state,
the new SGSN sends Update PDP Context Request (new SGSN Address, QoS
Negotiated, Tunnel Endpoint Identifier, ) to the GGSNs concerned. The GGSNs update
their PDP context fields and return an Update PDP Context Response (Tunnel Endpoint
Identifier). Note: If the RA update is an Inter-SGSN routeing area update initiated by an
MS in PMM-CONNECTED state, then the Update PDP Context Request message is
sent as described in the specification subclause "Serving RNS Relocation Procedures".

6) If the RA update is an Inter-SGSN RA Update, the new SGSN informs the HLR of the
change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to
the HLR.

7) If the RA update is an Inter-SGSN RA Update, the HLR sends Cancel Location (IMSI,
Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If
the timer described in step 2 is not running, then the old SGSN removes the MM
context. Otherwise, the contexts are removed only when the timer expires. It also
ensures that the MM context is kept in the old SGSN in case the MS initiates another
inter SGSN routeing area update before completing the ongoing routeing area update to
the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).

8) If the RA update is an Inter-SGSN RA Update, the HLR sends Insert Subscriber Data
(IMSI, subscription data) to the new SGSN. The new SGSN validates the MS's presence
in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be
attached in the RA, the SGSN rejects the Routeing Area Update Request with an
appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area

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Restricted) message to the HLR. If all checks are successful then the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.

9) If the RA update is an Inter-SGSN RA Update, the HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.

10) If Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routeing area update, then the association has to be established, and the new SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with ISI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI via a table in the SGSN. The SGSN starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HLR in step 8). The VLR creates or updates the association with the SGSN by storing SGSN Number.

11) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):

   a) The new VLR sends an Update Location (new VLR) to the HLR.

   b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.

   c) The old VLR acknowledges with Cancel Location Ack (IMSI).

   d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.

   e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).

   f) The HLR responds with Update Location Ack (IMSI) to the new VLR.

12) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the SGSN. VLR TMSI is optional if the VLR has not changed.

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13) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the SGSN, or if subscription checking fails, then the SGSN rejects the routeing area update with an appropriate cause. If all checks are successful then the new SGSN establishes MM context for the MS. The new SGSN responds to the MS with Routeing Area Update Accept (P-TMSI, VLR TMSI, P-TMSI Signature, **new CN identifier**).

14) The MS confirms the reallocation of the TMSIs by returning a Routeing Area Update Complete message to the SGSN.

15) The new SGSN sends a TMSI Reallocation Complete message to the new VLR if the VLR TMSI is confirmed by the MS.

NOTE: Steps 11, 12, and 15, are performed only if step 9 is performed.

Note: This case assumes no change on the Gs interface, and corresponds to the case where one LA is still handled by a single MSC/VLR. So SGSN derives the MSC/VLR address from LAI (current solution).

In the case where many MSC/VLR would handle the same LA, and Gs interface is used, the solution presented above should be enhanced by adding CN identifier (eventually associated with a CN type indicating CS) to message 1 (Routing area update request) and to message 13 (Routing area update accept). In addition CN identifier should be added in Gs interface to message 10 (Location update request) and to message 12 (Location update accept). This supposes that the SGSN is capable of deriving MSC address from LAI and CN identifier, or at least from only LAI (as long as one SGSN always selects same MSC address for same LA, no unnecessary inter MSC/VLR location update is performed if SGSN do not change).

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Another example of a procedure where the method to select
serving node based on CN identifier may be used, is a Combined
Cell / URA Update and SRNS Relocation Procedure.

This procedure is only performed for an MS in PMM-CONNECTED
state, where the Iur carries control signalling but no user
data.
The Combined Cell / URA Update and SRNS Relocation procedure is
used to move the UTRAN to CN connection point at the UTRAN side
from the source SRNC to the target RNC, while performing a cell
re-selection in the UTRAN. In the procedure, the Iu links are
relocated. If the target RNC is connected to the same SGSN as
the source SRNC, an Intra SGSN SRNS Relocation procedure is
performed. If the routeing area is changed, then this procedure
is followed by an Intra SGSN Routeing Area Update procedure.
The SGSN detects that it is an intra-SGSN routeing area update
by noticing that it also handles the old RA. In this case, the
SGSN has the necessary information about the MS and there is no
need to inform the HLR about the new MS location.

Before the Combined Cell / URA Update and SRNS Relocation and
the Routeing Area Update the MS is registered in the old SGSN.
The source RNC is acting as serving RNC.
After the Combined Cell / URA Update and SRNS Relocation and
the Routeing Area Update, the MS is registered in the new SGSN
The MS is in state PMM-CONNECTED towards the new SGSN, and the
target RNC is acting as serving RNC.

The Combined Cell / URA Update and SRNS Relocation procedure
for the PS domain is illustrated in Fig. 7. The sequence is
valid for both intra-SGSN SRNS relocation and inter-SGSN SRNS
relocation. The steps will be described by referring to the
numbering shown in Fig. 7.

1) The MS sends a Cell Update / URA Update message to the UTRAN, after having made cell re-selection. Upon reception of the message, the target RNC forwards the received message towards the source SRNC via Iur. Source SRNC decides to perform a combined cell / URA update and SRNS relocation towards the target RNC.

2) The source SRNC initiates the relocation preparation procedure by sending a Relocation Required message (Relocation Type, Cause, Source ID, Target ID, Source RNC to Target RNC Transparent Container) to the old SGSN. The source SRNC shall set Relocation Type to "UE not involved". Source RNC to Target RNC Transparent Container includes the necessary information for Relocation co-ordination, security functionality, and RRC protocol context information (including UE Capabilities).

3) The old SGSN determines from Target ID if the SRNS Relocation is intra SGSN SRNS relocation or inter SGSN SRNS relocation. In case of inter SGSN SRNS relocation the old SGSN initiates the relocation resource allocation procedure by sending a Forward Relocation Request (IMSI, Tunnel Endpoint Identifier Signalling, MM Context, PDP Context, Target Identification, UTRAN Transparent Container, RANAP Cause) message to the new SGSN. **The new SGSN address is derived from the target ID and the CN identifier which was previously sent to the MS.** . At the same time a timer is started on the MM and PDP contexts in the old SGSN, see Routeing Area Update procedure in subclause "Location Management Procedures (UMTS Only)". The Forward Relocation Request message is applicable only in case of inter SGSN SRNS relocation.

4) The new SGSN sends a Relocation Request message (Permanent NAS UE Identity, Cause, CN Domain Indicator, Source RNC to Target RNC Transparent Container, RABs To Be Setup) to the target RNC. For each RAB requested to be established, RABs To Be Setup shall contain information such as RAB ID, RAB parameters, Transport Layer Address, and Iu Transport Association. The RAB ID information element contains the NSAPI value, and the RAB parameters information element gives the QoS profile. The Transport Layer Address is the SGSN Address for user data, and the Iu Transport Association corresponds to Tunnel Endpoint Identifier Data.

After all necessary resources for accepted RABs including the Iu user plane are successfully allocated, target RNC shall send the Relocation Request Acknowledge (RABs setup, RABs failed to setup) message to the new SGSN. Target RNC will for each RAB to be setup (defined by an IP Address and a Tunnel Endpoint Identifier) receive both forwarded downstream PDUs from the source SRNC as well as downstream PDUs from the new SGSN.

5) When resources for the transmission of user data between target RNC and new SGSN has been allocated and the new SGSN is ready for relocation of SRNS, the Forward Relocation Response message (Cause, RANAP Cause, and Target RNC Information) is sent from new SGSN to old SGSN. This message indicates that the new SGSN and target RNC are ready to receive from source SRNC the downstream packets not yet acknowledged by MS, i.e., the relocation resource allocation procedure is terminated successfully. RANAP Cause is information from the target RNC to be forwarded to the source RNC. The Target RNC Information, one information element for each RAB to be setup, contains the RNC Tunnel Endpoint Identifier and RNC IP address for data forwarding from source SRNC to target RNC. The Forward Relocation Response message is applicable only in case of inter SGSN SRNS relocation.

6) The old SGSN continues the relocation of SRNS by sending a Relocation Command (RABs to be released, and RABs subject to data forwarding) message to the source SRNC. The old SGSN decides the RABs subject to data forwarding based on QoS, and those RABs shall be contained in RABs subject to data forwarding. For each RAB subject to data forwarding, the information element shall contain RAB ID, Transport Layer Address, and Iu Transport Association. The Transport Layer Address and Iu Transport Association is used for forwarding of DL N-PDU from source RNC to target RNC.

7) Upon reception of the Relocation Command message from the PS domain, the source RNC shall start the data-forwarding timer. When the relocation preparation procedure is terminated successfully and when the source SRNC is ready, the source SRNC shall trigger the execution of relocation of SRNS by sending a Relocation Commit (SRNS Contexts) message to the target RNC. The purpose of this procedure is to transfer SRNS contexts from the source RNC to the target RNC. SRNS contexts are sent for each

concerned RAB and contain the sequence numbers of the GTP-PDUs next to be transmitted in the uplink and downlink directions and the next PDCP sequence numbers that would have been used to send and receive data from the MS. For connections using RLC unacknowledged mode PDCP sequence numbers is not used.

8) After having sent the Relocation Commit message, source SRNC begins the forwarding of data for the RABs subject to data forwarding. The data forwarding at SRNS relocation shall be carried out through the Iu interface, meaning that the data exchanged between source SRNC and target RNC are duplicated in the source SRNC and routed at IP layer towards the target RNC.

9) The target RNC shall send a Relocation Detect message to the new SGSN when the relocation execution trigger is received. For SRNS relocation type "UE not involved", the relocation execution trigger is the reception of the Relocation Commit message from the Iur interface. When Relocation Detect message is sent, target RNC shall start SRNC operation.

10) After having sent the Relocation Detect message, target SRNC responds to the MS by sending a Cell Update Confirm / URA Update Confirm message. Both messages contain UE information elements and CN information elements. The UE information elements include among others new SRNC identity and S-RNTI. The CN information elements contain among others Location Area Identification and Routeing Area Identification. The procedure shall be co-ordinated in all Iu signalling connections existing for the MS.

11) Upon reception of Relocation Detect message, CN may switch the user plane from source RNC to target SRNC. If the SRNS Relocation is an inter SGSN SRNS relocation, the new SGSN sends Update PDP Context Request messages (new SGSN Address, SGSN Tunnel Endpoint Identifier, QoS Negotiated) to the GGSNs concerned. The GGSNs update their PDP context fields and return an Update PDP Context Response (GGSN Tunnel Endpoint Identifier) message.

12) When the MS has reconfigured itself, it sends the RNTI Reallocation Complete message to the target SRNC.

13) When target SRNC receives the RNTI Reallocation Complete message, i.e. the new SRNC-ID + S-RNTI are successfully exchanged with the UE by the radio protocols,

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target SRNC shall initiate the Relocation Complete procedure by sending the Relocation
Complete message to new SGSN. The purpose of Relocation Complete procedure is to
indicate by the target SRNC the completion of relocation of SRNS to the CN. If the user
plane has not been switched at Relocation Detect, the CN shall upon reception of
Relocation Complete switch the user plane from source RNC to target SRNC, If the
SRNS Relocation is an inter SGSN SRNS relocation, the new SGSN signals to the old
SGSN the completion of the SRNS relocation procedure by sending a Forward
Relocation Complete message.

14) Upon receiving the Relocation Complete message or if it is an inter SGSN SRNS
relocation; the Forward Relocation Complete message, the old SGSN sends an Iu
Release Command message to the source RNC. When the RNC data-forwarding timer
has expired the source RNC responds with an Iu Release Complete.

15)     After the MS has finished the Cell / URA update and RNTI reallocation procedure
and if the new Routeing Area Identification is different from the old one, the MS
initiates the Routeing Area Update procedure. See subclause "Location Management
Procedures (UMTS Only)". Note that it is only a subset of the RA update procedure
that is performed, since the MS is in PMM-CONNECTED state.


Note that when the RAU procedure is performed, the MS
indicates the same CN identifier as used by old SGSN to find
the new SGSN , so that the  SGSN that is selected by the new
SRNC, is the same as the one that  has already been selected
by the old SGSN.


An alternative solution would be that the old SGSN selects
anyone of the SGSN capable to connect to the target RNC based
on target ID. Then the new SGSN sends its CN identifier to
the MS, e.g. by adding CN identifier in message 4 (Relocation
Request) and 10 (Cell Update Confirm / URA Update Confirm
message). Then the MS uses the CN id for the update selecting
the right SGSN.

In a prefered implementation, the coding of the CN identifier
is optimised to allow enough serving nodes to handle the same
area, but not to increase too much radio signaling. The
preferred coding is therefore to use 4 bits, providing 16
serving nodes but not much overhead.

Also to simplify implementation, a given code (e.g. 0000)
should indicate the default serving node for all areas. And
another code (e.g. 0001) should indicate the secondary default
serving node. This implementation would reduce need to
configure an additional parameter as default. In addition, when
a node (e.g. RNC) selects the default, it can be implemented as
using known default value of CN identifier (e.g. 0000) to query
the list and retrieve (default) serving node address.

Concerning Gs interface and a simultaneous PS/CS attachment, if
an association between the SGSN and the MSC is created (e. g.
the UE (user equipment) performs a combined PS / CS attach),
the SGSN is provided with, or has access to, a translation
table to derive the MSC address from the RAI. Changes are
needed to the translation table if multiple MSCs may control
the same location area. An additional identifier, the MSC
Identifier, may be provided to find a specific MSC controlling
a location area.

Although preferred embodiments have been described above, the
invention is not limited thereto and may also be implemented in
networks of different types using serving nodes of different
structure such as MSC/VLR.

Also the claims should be taken in their broad meaning, so that
target ID which identifies an element handling an area, can in
fact be considered as the identifier of an area, i.e. the area
handled by this element.

CLAIMS

1. System for providing a connection in a communication network
comprising several network elements and being adapted to route
a connection via a first network element and one or more of
alternatively selectable second network elements, at least one
of the network elements storing a list of second network
elements selectable by first network element, said list being
accessible using an identifier identifying an area and/or an
identifier identifying a desired second network element, said
identifiers being transmitted from another network element.


2. System according to claim 1, wherein the area identifier is
a Location or Routing Area Identifier (RAI)or target ID, at
least two second network elements being assigned to the same
identifier.


3. System according to any one of the preceding claims, wherein
the identifier is a CN identifier.


4. System according to any one of the preceding claims, wherein
information on at least two second network elements being
assigned to the transmitted identifier is sent to the first
network element.


5. System according to any one of the preceding claims, wherein
the list of selectable second network elements is sent to the
first network element in a defined order.


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6. System according to claim 5, wherein the order is depending on the load of the second network elements indicated in the list.

7. System according to claim 5 or 6, wherein the order is depending on the geographical distance between the first and the second network elements.

8. System according to claim 5, 6, or 7, wherein the order is depending on the address of the first network element.

9. System according to any one of the preceding claims, wherein the network is a packet-switched network.

10. System according to any one of the preceding claims, wherein the first network element provides radio access to one or more user equipments.

11. System according to any one of the preceding claims, wherein the second network elements are serving nodes, preferably SGSNs.

12. System according to any one of the preceding claims, wherein the at least one network element storing the list is a DNS server.

13. System according to claim 12, wherein the DNS server is adapted to return a list of IP addresses of second network elements.

14. System according to claim 13, wherein the DNS server returns the list of IP addresses of second network elements together with their names, preferably their canonical names.

15. System according to any one of the preceding claims, wherein, when a second network element is to be subjected to an operation blocking its future connection handling capability at least temporarily or partly, this second network element is excluded from the list a defined time before starting the operation.

16. System according to any one of the preceding claims, wherein the first network element is adapted to detect the identifier from a message to be sent from a third, connection originating or terminating network element to the first or one of the second network elements, or to deduce the identifier from other information related to the third network element such as location information.

17. System according to any one of the preceding claims, wherein the identifier is transmitted as part of a message to be sent from a third, connection originating or terminating network element to the first network element or to one of second network elements.

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18. System according to any one of the preceding claims, wherein one of the second network elements is set as a default second network element to be used for handling the connection when no other second network element is selected.


19. System according to any one of the preceding claims, wherein one of the second network elements is set as a master second network element to be used for handling the connection or transmitting information to another second network element when said another second network element is selected for handling the connection.


20. System according to claim 19, wherein the information to be transmitted to said another second network element is context information.


21. Method for selecting an address in a communication network comprising several network elements, a first network element being adapted to select the address of one or more of alternatively selectable second network elements, at least one of the network elements storing a list of selectable second network elements, wherein said list is accessed using an identifier identifying an area and/or an identifier identifying a desired second network element, said identifier being transmitted from another network element or being generated by default.


22. Method according to claim 21, wherein the identifier is a Location or Routing Area Identifier (RAI) or target ID, at least two second network elements being assigned to the same identifier.

23. Method according to claims 21 or 22, wherein the identifier is a CN identifier.

24. Method according to claim 21, 22, or 23, wherein information on at least two second network elements being assigned to the transmitted identifier is sent from the network element storing the list to the first network element.

25. Method according to any one of the preceding claims 21 to 24, wherein the list of selectable second network elements is sent to the first network element in a defined order.

26. Method according to claim 25, wherein the order is depending on the load of the second network elements indicated in the list.

27. Method according to claim 25 or 26, wherein the order is depending on the address of the first network element.

28. Method according to claim 25, 26 or 27, wherein the order is depending on the geographical distance between the first and the second network elements.

29. Method according to any one of the preceding claims 21 to 28, wherein the network is a packet-switched network.

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30. Method according to any one of the preceding claims 21 to 29, wherein the second network elements are serving nodes, preferably SGSNs.

31. Method according to any one of the preceding claims 21 to 30, wherein the at least one network element storing the list is a DNS server.

32. Method according to claim 31, wherein the DNS server returns a list of IP addresses of second network elements.

33. Method according to claim 32, wherein the DNS server returns the list of IP addresses of second network elements together with their names, preferably their canonical names.

34. Method according to any one of the preceding claims 21 to 33, wherein, when a second network element is to be subjected to an operation blocking its future connection handling capability at least temporarily or partly, this second network element is excluded from the list a defined time before starting the operation.

35. Method according to any one of the preceding claims 21 to 34, wherein the first network element detects the identifier from a message to be sent from a third, connection originating or terminating network element to the first or one of the second network elements, or deduces the identifier from other information related to the third network element such as location information.

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36. Method according to any one of the preceding claims 21 to 35, wherein the identifier is transmitted as part of a message to be sent from a third, connection originating or terminating network element to the first network element or to one of second network elements.

37. Method according to any one of the preceding claims 21 to 36, wherein one of the second network elements is set as a default second network element to be used for handling the connection when no other second network element is selected.

38. Method according to any one of the preceding claims 21 to 37, wherein one of the second network elements is set as a master second network element to be used for handling the connection or transmitting information to another second network element when said another second network element is selected for handling the connection.

39. Method according to claim 38, wherein the information to be transmitted to said another second network element is context information.

40. User equipment, preferably to be used in a system according to any one of claims 1 to 20, or in a method according to any of claims 21 to 39, wherein the user equipment is adapted to store a Core Network (CN) identifier, in particular the latest CN identifier sent by the network, and to insert the CN identifier in radio signaling.

41. User equipment according to claim 40, wherein the stored CN identifier is the latest CN identifier sent by the network.

42. User equipment according to claim 41, wherein the stored CN identifier is a preconfigured CN identifier, which is always sent from the user equipment in radio signaling.

43. User equipment according to claim 42, wherein the preconfigured CN identifier is stored on a SIM card of the user equipment.

44. User equipment according to claim 41, 42, or 43, wherein the user equipment is a mobile station.

45. System wherein different Serving nodes assigned to different operators are adapted to use the same access network for access to a user equipment, the access network being adapted to select an appropriate Serving node by using a CN identifier.

46. System according to claim 45, wherein the access network is a RAN (Radio Access Network) for radio access to a user equipment.

47. System according to claim 45 or 46, wherein the access network is assigned to another operator than the Serving nodes.

48. Controller, in particular for use in a system as defined in any one of claims 1 to 20, or 45 to 47, or in a method

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according to any one of claims 21 to 44, being adapted to
select a serving network element for handling a connection,
either from a list of serving network elements, or depending on
an identifier provided by another network element.


49. Controller according to claim 48, being implemented as a
Radio Network Controller (RNC).


50. Controller according to claim 48, being implemented as a
Base Station Controller (BSC).


51. Network element, in particular for use in a system as
defined in any one of claims 1 to 20, or 45 to 47, or in a
method according to any one of claims 21 to 44, containing a
list of serving network elements.


52. Network element according to claim 51, being implemented as
a DNS (Domain Name System) server.


53. Serving network element, in particular for use in a system
as defined in any one of claims 1 to 20, or 45 to 47, or in a
method according to any one of claims 21 to 44, being adapted
to request connection information such as context informatiom,
e.g. PDP context information, from another serving network
element whem taking over the handling of a connection which is
or was previously handled by the another serving network
element.

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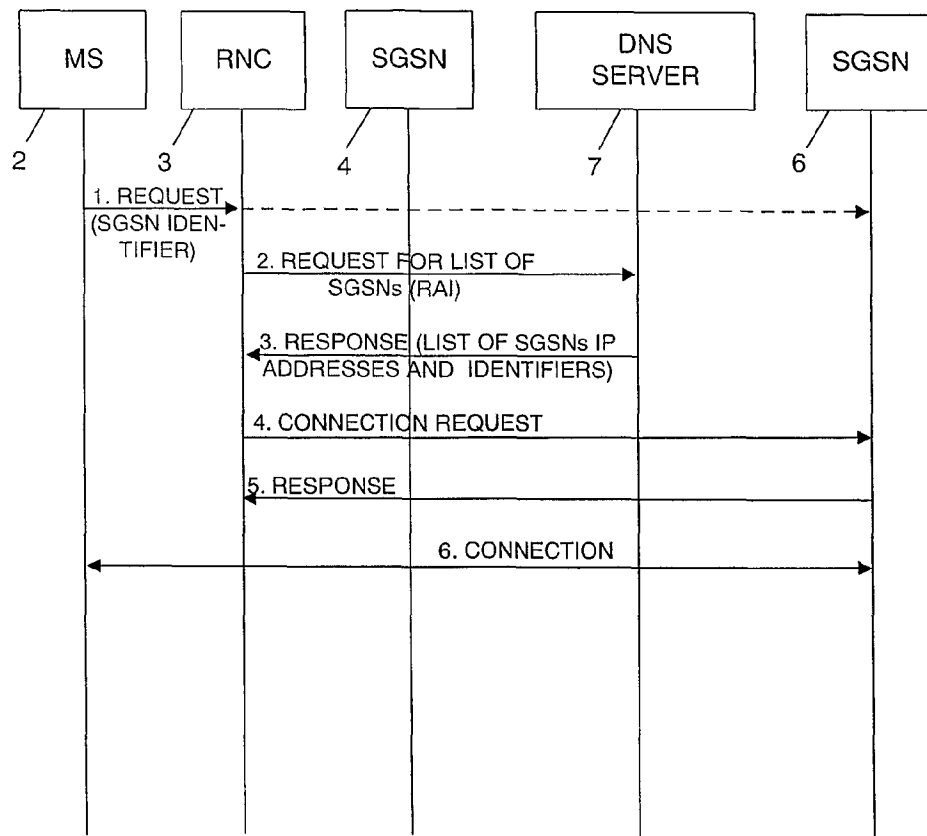54. Network element according to claim 53, being implemented as a SGSN.
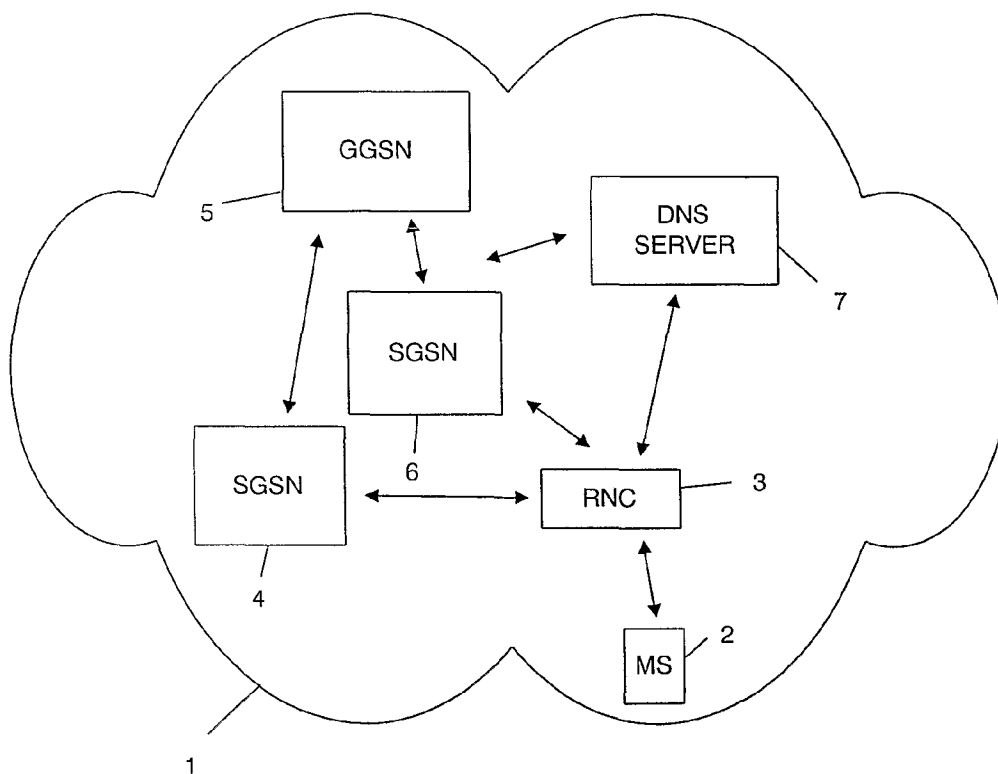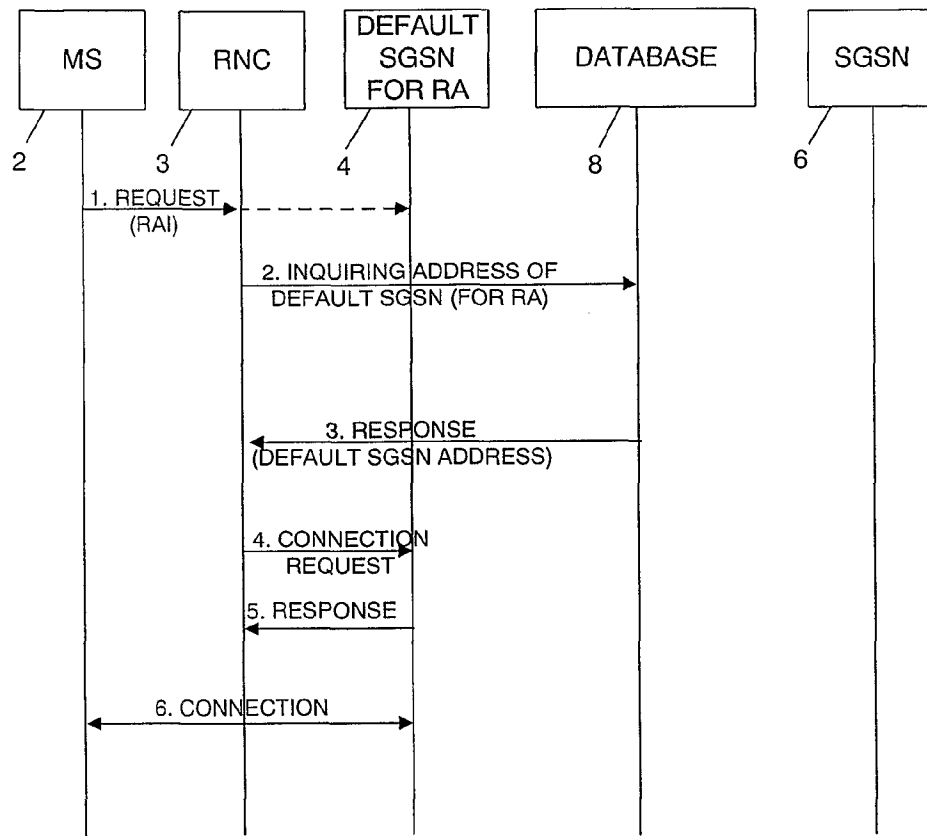
**Fig. 1**
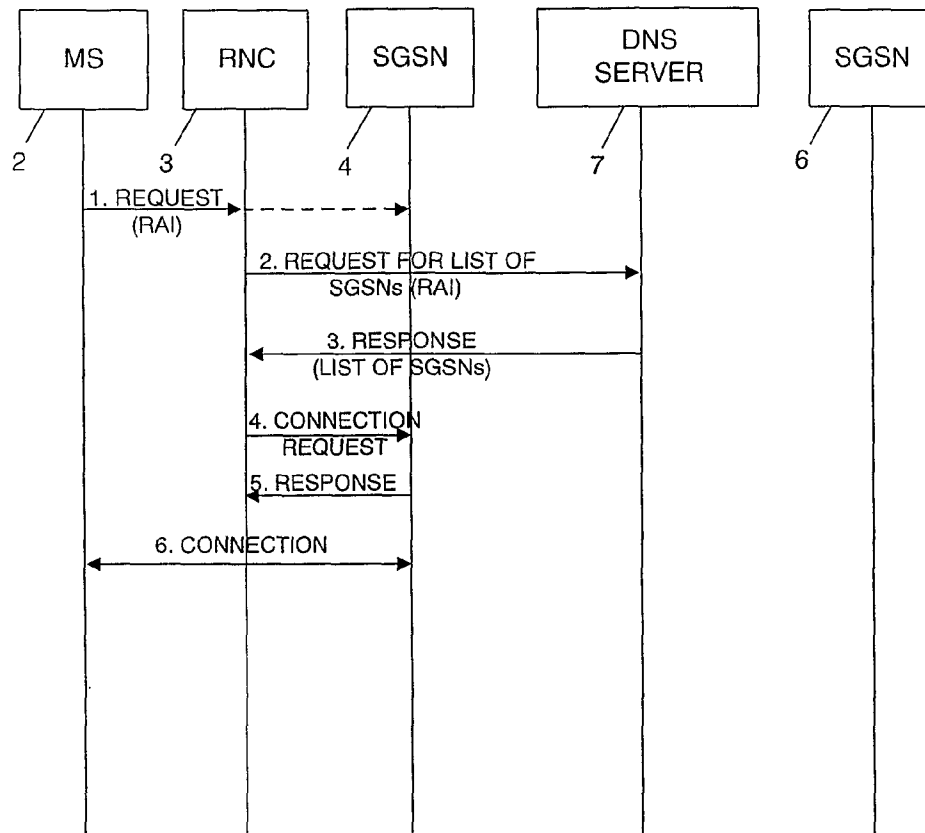
**Fig. 2**

**Fig. 3**

**Fig. 4**

| SGSN | IP ADDRESS OF SGSN | SGSN NAME (SGSN IDENTIFIER) | ROUTING AREA |
|---|---|---|---|
| SGSN1 | 1.2.3.4 | 2G_SGSN IDENTIFIER_13 | RA1 |
| SGSN2 | 1.2.3.5 | 3G_SGSN IDENTIFIER_14 | RA1 |
| SGSN3 | 1.2.3.6 | 2G_SGSN IDENTIFIER_15 | RA1 |
| SGSN4 | 1.2.3.7 | 3G_SGSN IDENTIFIER_16 | RA1 |
| SGSN1 | 1.2.3.4 | 2G_SGSN IDENTIFIER_13 | RA2 |
| SGSN2 | 1.2.3.5 | 3G_SGSN IDENTIFIER_14 | RA2 |
| SGSN3 | 1.2.3.6 | 2G_SGSN IDENTIFIER_15 | RA2 |
| SGSN5 | 1.2.3.8 | 3G_SGSN IDENTIFIER_16 | RA2 |
| . | . | . | . |
| . | . | . | . |
| . | . | . | . |

# Fig. 5
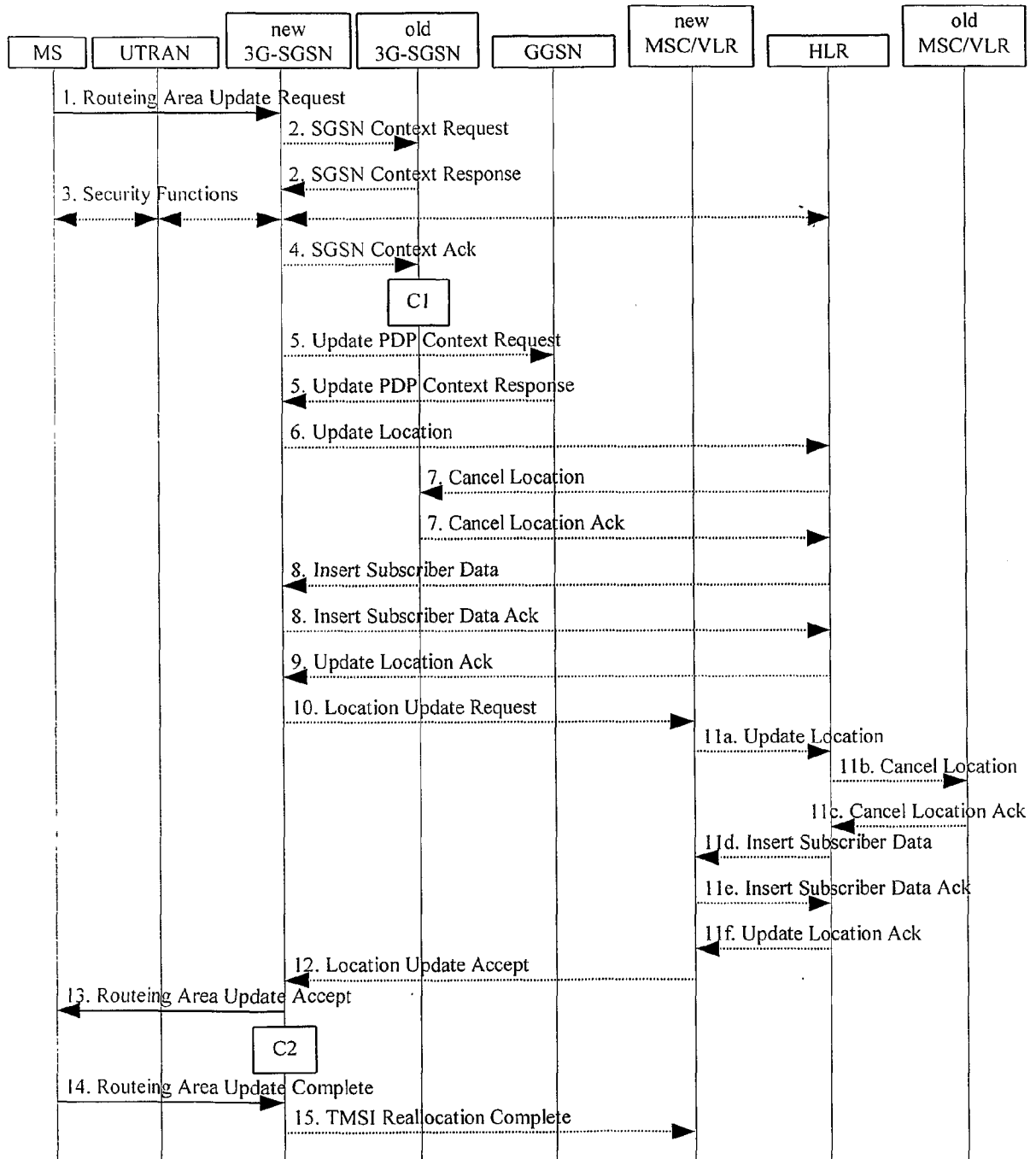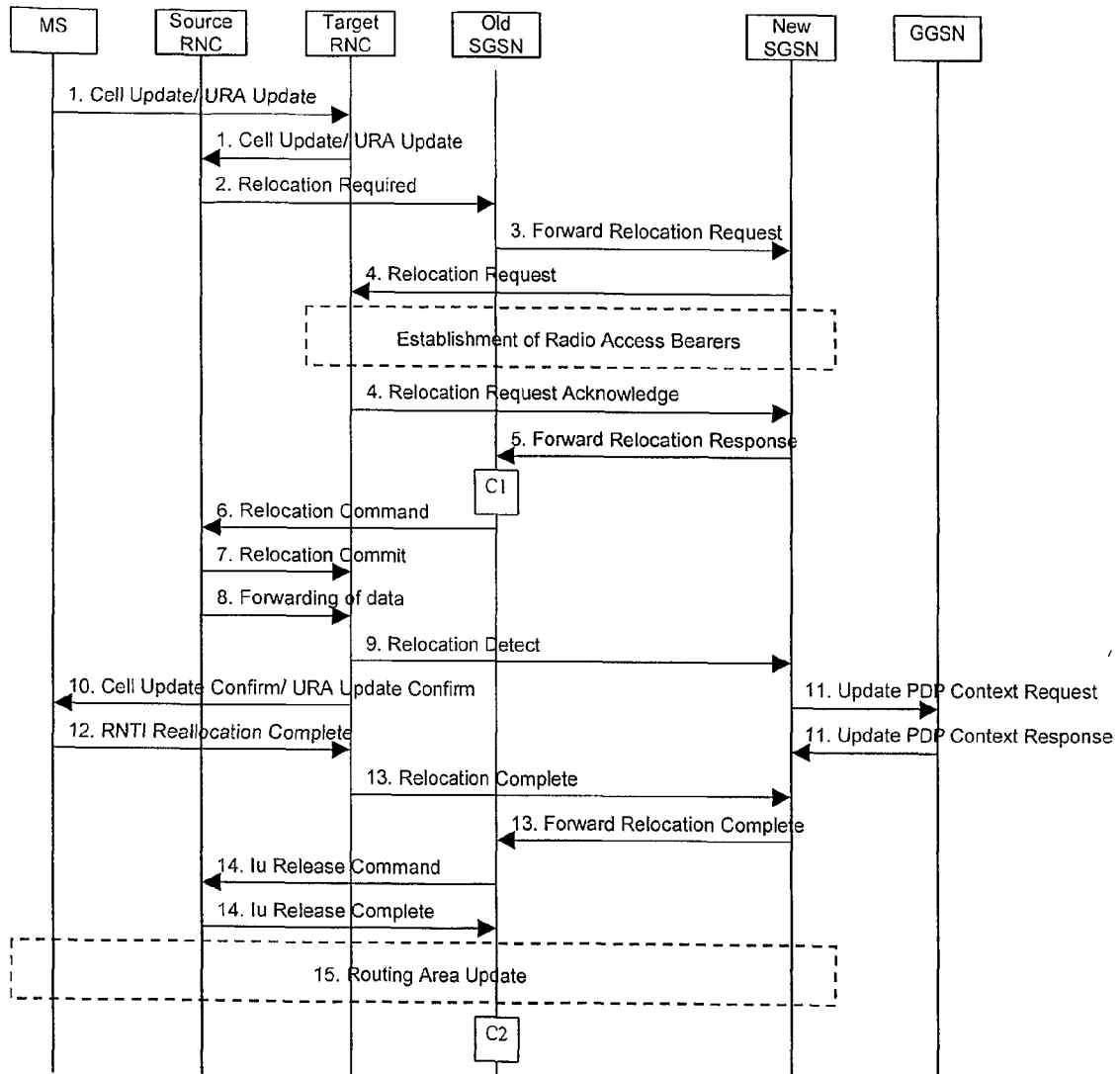
**Fig. 6**

Fig. 7

**A. CLASSIFICATION OF SUBJECT MATTER**
IPC 7   H04L12/56     H04Q7/22

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   H04L   H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, IBM-TDB, INSPEC, COMPENDEX

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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[X] Further documents are listed in the continuation of box C.     [X] Patent family members are listed in annex.

° Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 28 February 2001 | 19/03/2001 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016 | Eraso Helguera, J |

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